

UNITED STATES DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

TECHNICAL GUIDE  
SECTION IV

STATEWIDE  
Irrigation Water Conveyance 428-C-1

Irrigation Water Conveyance (ft)

Galvanized Steel Ditch and Canal  
Lining

Definition

A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch or irrigation canal or lateral.

Scope

This standard applies to linings made of galvanized steel installed in a preformed ditch or canal section.

Linings to which this standard apply are restricted to ditches having characteristics as follows:

Bottom width ..... Not to exceed 30 in.  
Velocity ..... Not to exceed 15 ft/s

This standard applies to both the ditch section and the steel lining.

Purpose

To prevent waterlogging of land, to maintain water quality, to prevent erosion, and to reduce water losses.

Conditions where practice applies

Ditches and canals to be lined shall serve as integral parts of an irrigation water distribution or conveyance system designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

Water supplies and irrigation deliveries for the area served shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Lined ditches and canals shall either be located where they will not be susceptible to damage from

side drainage flooding or be protected from such damage.

Steel linings shall not be installed in areas high in salt or other chemical concentrations injurious to galvanized steel unless the liners are protected with coatings or anodic protection specifically designed to protect the liner from these chemicals.

Design criteria

**Capacity.** A lined ditch or canal shall have enough capacity to meet its requirement as part of the planned irrigation water distribution or conveyance system without danger of overtopping. Design capacity shall be based upon the following, whichever is greater:

1. The capacity shall be adequate to deliver the volume of water required to meet the peak consumptive use of the crops.
2. The capacity shall be large enough to provide an adequate irrigation stream for all methods of irrigation planned.

For design purposes, the carrying capacity of steel-lined ditches and canals shall be considered to be equal to the capacity as computed by Manning's Formula, using a coefficient of roughness  $n$  of not less than 0.013.

**Velocity.** A design velocity in excess of 1.7 times the critical velocity shall be restricted to straight reaches that discharge into a section or structure designed to reduce the velocity to less than the critical velocity. The maximum velocity in these straight reaches shall be 15 ft/s.

**Freeboard.** The required freeboard varies with the size of the ditch or canal, the velocity of the water, the horizontal and vertical alignment, the amount of storm or waste water that may be intercepted, and the change in the water surface elevation that may occur when any control structure is operating. The minimum freeboard for any lined ditch or canal shall be 3 in.

If the velocity is within  $\pm 30$  percent of critical, the freeboard shall be at least 6 in. The minimum freeboard requirement is based on the assumption that the finished channel bottom elevations will vary no more than 0.1 ft from the design elevations. Construction deviations greater than 0.2 ft shall not be permitted. If a construction deviation greater than 0.1 ft is permitted, the minimum freeboard shall be increased an additional 3 in.

Additional freeboard shall be provided as required by slope, velocity, depth of flow, alignment, obstructions, curves, and other site conditions.

**Water surface elevations.** All lined ditches and canals shall be designed so that the water surface elevations at field takeout points are high enough to provide the required flow onto the field surface. If ditch checks or other control structures are to provide the necessary head, the backwater effect must be considered in computing freeboard requirements. The required elevation of the water surface above the field surface varies according to the type of takeout or device used and the amount of water to be delivered. A minimum head of 4 in. shall be provided.

**Ditch or canal pad or foundation.** Ditch and canal banks shall be built up with earth to a height sufficient to support the full height of the lining and to provide an anchorage for the top edge of the lining. In cut sections, other than in rock, a berm shall be constructed not less than 2 in. above the top of the lining.

Berms and ditch banks shall be wide enough to prevent excessive deposition in cut sections and to insure support of the lining in fill sections. The minimum width shall be 1 ft. If the bank or berm is to be used as a roadway, the minimum top width shall be adequate for the purpose.

Outside bank slopes and slopes above the berm elevation in cut sections must be flat enough to insure stability.

**Related structures.** Plans for ditch or canal lining installations shall provide for adequate inlets, outlets, turnouts, checks, crossings, and other related structures needed for successful conservation irrigation.

Structures shall be constructed or installed in such a way that the capacity or the freeboard of the ditch is not reduced and the effectiveness of the lining is not impaired.

All structures shall meet SCS standards and specifications for the type of structure used.

Bulkheads, formed to fit the lining and of sufficient size to extend at least 12 in. into the earthen ditch pad for the entire width of the ditch lining, shall be installed at the beginning and end of the lining section and at intervening points, as needed, to provide adequate anchorage.

**Materials.** Galvanized lining material shall meet the requirements detailed in the specifications under "Materials."

#### Plans and specifications

Plans and specifications for installing galvanized steel irrigation ditches and canal linings shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

## Irrigation Water Conveyance

### Galvanized Steel Ditch and Canal Lining Specifications

#### Installation

**Foundation preparation.** The foundation area for all ditch embankments or ditch pads or both shall be cleared of all trees, weeds, sod, loose rock, boggy soil, or other material not suitable for the subgrade. All trees having a root system that can damage the lining shall be removed.

**Placement of earthfill.** The moisture content and methods of placing and compacting the embankment and backfill materials shall be conducive to a firm, stable embankment. Fill material shall be placed in horizontal lifts of 8 in. maximum thickness and shall be uniformly compacted to the density of the surrounding material to the top of the ditch lining. Embankment materials shall be free of brush, roots, sod, large rocks, frozen soil, or other material not suitable for making compacted fills.

**Excavation.** Ditches and canals shall be excavated to the neat lines of the specified cross section and finished with a smooth, firm surface. Overexcavated areas shall be backfilled with moist soil compacted to the density of the surrounding material. No abrupt deviation from design grade or horizontal alignment shall be permitted.

**Placement of lining.** The lining shall be placed so that there are no abrupt deviations from the de-

signed alignment. Joints shall be flexibly joined to absorb changes in length because of temperature and shall be constructed so that they remain watertight. The anchorage section of the lining shall be adequately covered with earth. Lining grades shall at no place vary more than 0.2 ft above or below the design grade, and deviations greater than 0.1 ft shall be allowed only in canals for which the design freeboard is 6.0 in. or more. Opposite sides of the lining shall be within 0.1 ft of the same elevation.

**Construction operations.** Construction operations shall be carried out in such a manner that erosion and air and water pollution are minimized and held within legal limits. The completed job shall be workmanlike and present a good appearance.

#### Materials

Galvanized sheet steel used in the linings, battens, related structures, and accessories shall conform to the criteria in ASTM-A-525, Coating class 1.25 oz/ft, or in Federal Specification QQ-S-775C, Type 1, Class d.

Minimum thickness of the lining shall be 24 gage for individual sheets 84 in. or less in width and 22 gage for wider sheets. The edges of the sheet linings shall be rolled or pressed into a shape that will provide added strength at the corners and firm anchorage into the ditch at the top of the lining.

Minimum thickness of steel used for bulkheads and related structures shall be 20 gage in accord with ASTM-A-446, Grade C, Steel.

Fasteners used in assembly of liners and structures shall be zinc or cadmium plated.

Sealer materials shall be able to withstand temperature variations expected at the site.

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NATIONAL  
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## **Irrigation Water Conveyance Galvanized Steel Ditch and Canal Lining (ft)**

### **Planning considerations for water quantity and quality**

#### *Quantity*

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, and deep percolation, and ground water recharge.
2. Effects on downstream flows or aquifers that would affect other water uses or users.
3. Potential use for irrigation water management.
4. Potential changes in growth and transpiration of vegetation located next to the conveyance because of the elimination of leakage from the system.

#### *Quality*

1. Effects of installing the lining on the erosion of the earth conveyance and the movement of sediment and soluble and sediment-attached substances carried by water.
2. Effects on the movement of dissolved substances to ground water.
3. Effects on wetlands or water-related wildlife habitats.
4. Effects on the visual quality of water resources.

## IRRIGATION WATER CONVEYANCE

## GALVANIZED STEEL DITCH AND CANAL LINING

The following additional standards apply to galvanized steel ditch and canal linings.

Design CriteriaInstallation Requirements

Installation shall be in accordance with the requirements set forth in Montana Construction and Construction Material Specification MT-428-C.

Materials

All materials described and required in this standard shall meet or exceed the minimum requirements stated in Montana Construction and Construction Material Specification MT-428-C.

Vegetation

Disturbed areas not otherwise covered or protected shall be established to grass as soon as practicable after construction. Seedbed preparation, seeding, fertilizing, and mulching shall comply with instructions in local technical guides. The vegetation shall be maintained and undesirable species controlled by chemical or mechanical means.

Plans and Specifications

Montana Construction and Construction Material Specification MT-428-C applies to this practice. Additional Montana Construction and Construction Material Specifications are required and shall be compiled and attached to MT-428-C.

If other additional specifications or measurement and payment clauses are required, they shall be in keeping with the requirements of Standard Construction and Material Specifications--West.